

### Cardiac arrhythmias induced by hypokalaemia and potassium loss during maintenance digoxin therapy

Sir:

I would like to make two observations about the interesting paper by Steiness and Olesen (*British Heart Journal* (1976), 38, 167).

Both premature ventricular and atrial contractions are commonly seen, even in asymptomatic patients, during continuous cardiac monitoring in the absence of hypokalaemia and digoxin toxicity (Hinkle *et al.*, 1969). Since similar arrhythmias were ascribed to digitalis toxicity and hypokalaemia in Dr. Steiness's study, it is unfortunate that a control period of monitoring before withdrawal of potassium supplements and/or a period of monitoring during reintroduction of potassium was not included in the experimental design.

The postulated increase in  $K^+$  gradient between the intracellular and extracellular compartment would be more likely to reduce automaticity rather than increase it as suggested by the authors, since in the absence of alteration of  $K^+$  permeability, which may occur with hypokalaemia (Carmeliet, 1961), this change would lead to hyperpolarization. Such a change might precipitate arrhythmias by encouraging re-entry.

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#### References

- Carmeliet, E. E. (1961). The potassium and chloride permeability in Purkinje fibres. In *The Specialised Tissue of the Heart*, pp. 108–114. Ed. by A. Paes de Carvalho, W. C. deMello, and B. F. Hoffman. Elsevier, New York.

Hinkle, L. E., Carver, S. T., and Stevens, M. (1969). The frequency of asymptomatic disturbances of cardiac rhythm and conduction in middle-aged men. *American Journal of Cardiology*, 24, 629–650.

This letter was shown to Drs Steiness and Olesen who reply as follows:

We welcome Dr. Hall's comments and forward the following reply:

As a baseline, our patients had a 24-hour period of close observation before withdrawal of potassium. The arrhythmias described are those developing during the period of metabolic balance study.

We agree that the increased  $K^+$  gradient between the intracellular and extracellular compartments during hypokalaemia leads to hyperpolarisation of the cells. There is evidence that in this setting the slope of the diastolic depolarisation is enhanced leading to increased automaticity of pacemaker fibres (Gettes and Surawicz, 1968; Vassalle, 1965). On the other hand, the precipitation of arrhythmias resulting from an accelerated re-entry mechanism is not excluded.

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#### References

- Gettes, L. S., and Surawicz, B. (1968). Effects of low and high concentrations of potassium on the simultaneously recorded Purkinje and ventricular action potentials of the perfused pig moderator band. *Circulation Research*, 23, 717–729.
- Vassalle, M. (1965). Cardiac pacemaker potentials of different extra- and intracellular K concentrations. *American Journal of Physiology*, 208, 770–775.